Lecture Zero

MTH 401 : Discrete Mathematics

Department of Mathematics
Lovely Professional University
Phagwara, Punjab

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Course Details

Course Credits

L-T-P : 3-0-0

Course Objectives

Through this course students should be able to

- understand various ways to prove or disapprove some logical statements.
- solve recurrence relation by using different methods.
- describe the concept of graphs and their properties.
- give essential knowledge of discrete mathematics to students.
- understand various concepts of number theory and its applications.

Books

Text Book

- DISCRETE MATHEMATICS AND ITS APPLICATIONS (SIE) by KENNETH H. ROSEN, MCGRAW HILL EDUCATION, 7th Edition, (2011)

Reference Books

- 1. HIGHER ENGINEERING MATHEMATICS by B. V. RAMANA, MC GRAW HILL , 10th Edition, (2007)

Course Assessment Model

Components	Marks	Weightage out of 100
Attendance	5 Marks	5 Marks
CA (Best two out of three tests)	30 Marks each	25 Marks
MTE	40 Marks	20 Marks
ETE	70 Marks	50 Marks

Note: One CA can be waived off if student register for the respective MOOCs

MOOCs details

This course is mapped with MOOCs "noc19-cs49 Discrete Mathematics by NPTEL)

Course Id	Discipline	Course Name	Duration	Course Start Date	Course End Date	Exam date	Link to join	Fee
noc19-cs49	Computer Science and Engineering	Discrete Mathematics (IITG)	12 Weeks	29-Jul-19	18-Oct-19	17-Nov-19	https://swayam.gov.in/nd1_noc19_cs49/	Rs 1000/

If a student registers for this course and clear it then one academic task can be waived off depending upon the result.

Example : if a student get 50% marks in MOOCs exam then he will be awarded 50% marks for one academic task

If the student appears in both academic task and MOOC then best of the two will be considered

Course Contents

- Logic and Proofs
- Recurrence relations with constant coefficients
- Counting principles and relations
- Graphs
- Tree graphs, Applications of trees, Tree traversal
- Number theory and its application in cryptography

Learning Outcomes

On successful completion of the course, the students should be able to:

- learn the recurrence relation, Solution of a recurrence relation, Homogeneous linear recurrence relation with constant coefficients.
- understand Relations and their properties, Equivalence relations, Partial ordering relations, Lattice, Sub lattice.
- understand graph terminology and special types of graph then explore it in the graph isomorphism, shortest path problem and connectivity.
- apply the divisibility, greatest common divisor and congruence in Cryptography.
- describe various ways to prove or disapprove some logical statements.

Why to study logics and Proof ?

What skills do you need to study Computer Science/ IT?

You can solve problems

You like numbers

You are a good logical thinker.

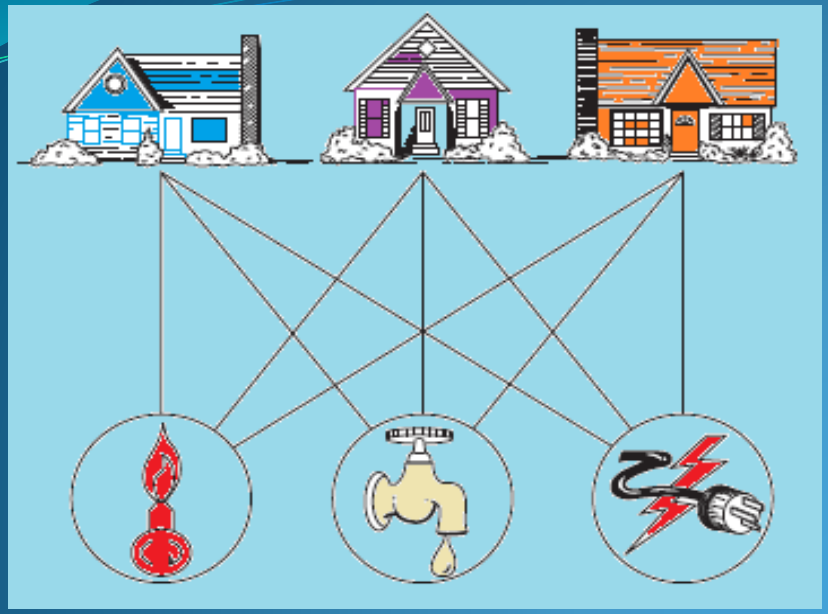
Computer programs are written in special, symbolic languages, e.g., Fortran, C++, Lisp, Prolog. These languages contain features of logical symbolism, and Lisp and Prolog are derived from formal languages for logic. Through such connections, the study of logic can help one in the design of programs.

Applications of Recurrence Relation and Graph Theory...?

Solution of tower of Hanoi game for n disk?

Discs	Moves
1	1
2	3
3	7
4	15
5	?
n	?

Solution of Tower of Hanoi game can be obtained by first order linear recurrence relation y_{k+1}-2$y_k = 1$ under Y(0)=0]. For more details please visit https://www.mathsisfun.com/games/towerofhanoi.html



Application of graph theory

Consider the problem of joining three houses to each of three separate utilities, as shown in

Figure . Is it possible to join these houses and utilities so that none of the connections cross?

?

In this section we will study the question of whether a graph can be drawn in the plane

without edges crossing. In particular, we will answer the houses-and-utilities problem.

Timetabling problems – complications

- A limited number of classroom are available.
- If there are l lessons scheduled in a p-period timetable, then how many rooms are needed?
- At least $\{l/p\}$ rooms are needed.
- It is possible to arrange l lessons in p periods where at most $\{l/p\}$ rooms are occupied in any one period.
- More complications: teachers are not available for every period, they need their tea breaks, etc. etc.

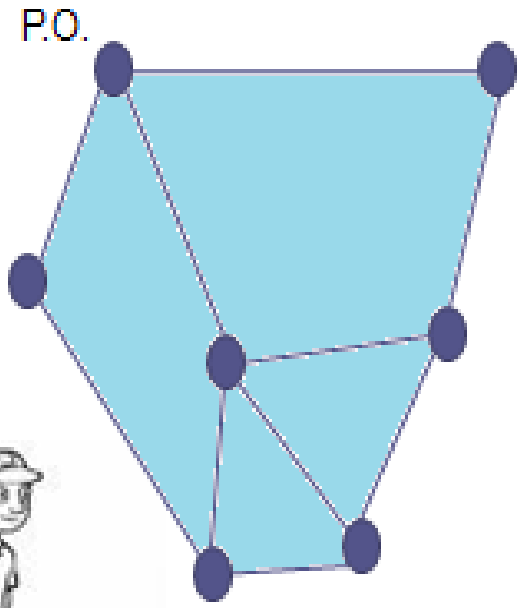
Assignment problem

There are 50 students in the class and teacher needs to prepare minimum number of class test for them in a way such that no two consecutive students get the same assignment.

It can be done via graph coloring , teacher can find chromatic no. of graphical representation of students

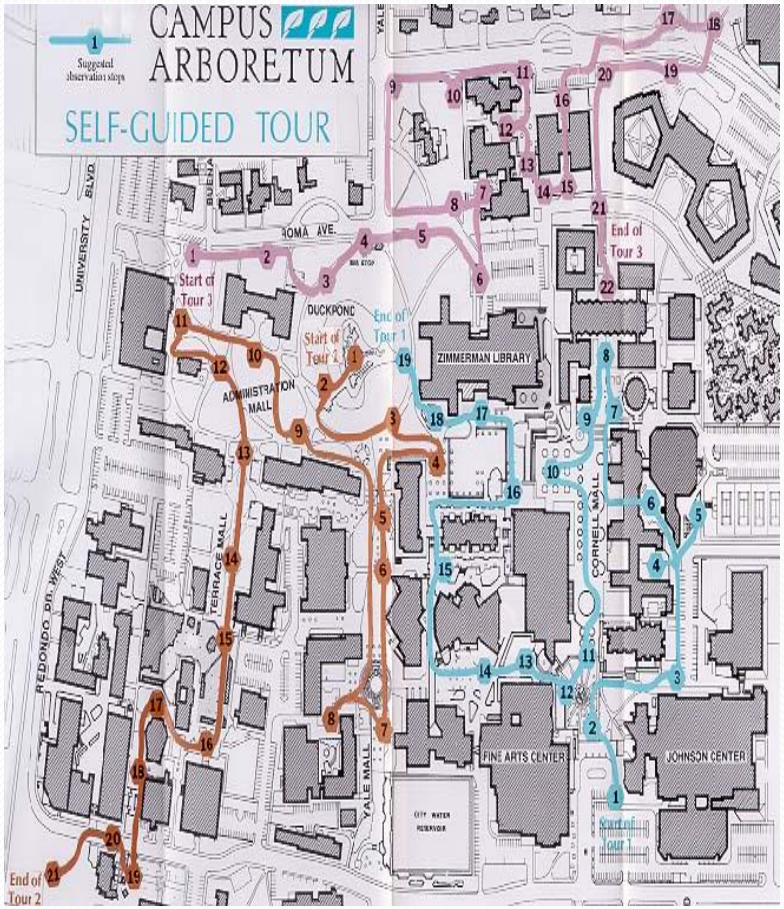
Postman Problem

- A postman begins in the post office, has to traverse all the streets, and returns to the post office in a shortest possible distance.



Facility location (A problem in OR)

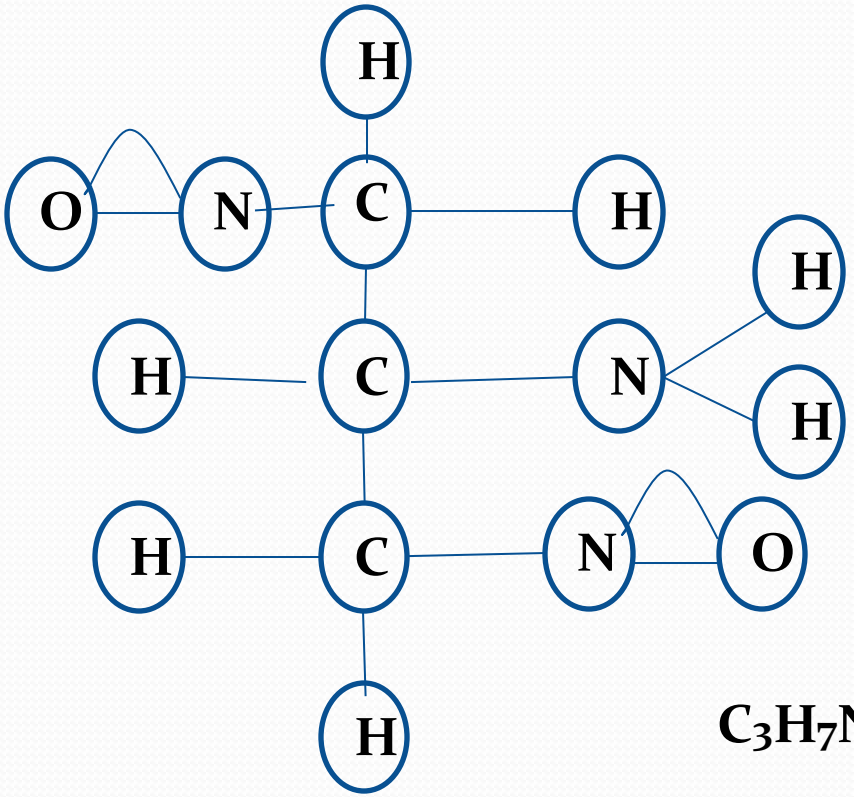
- Placing facilities that serve certain clients with certain demands in a way that minimizes the total cost.
- E.g., placing hospitals, police stations in a city, warehouses that serve shops, placement of content distribution servers on the Internet, etc.
- Problem is intractable



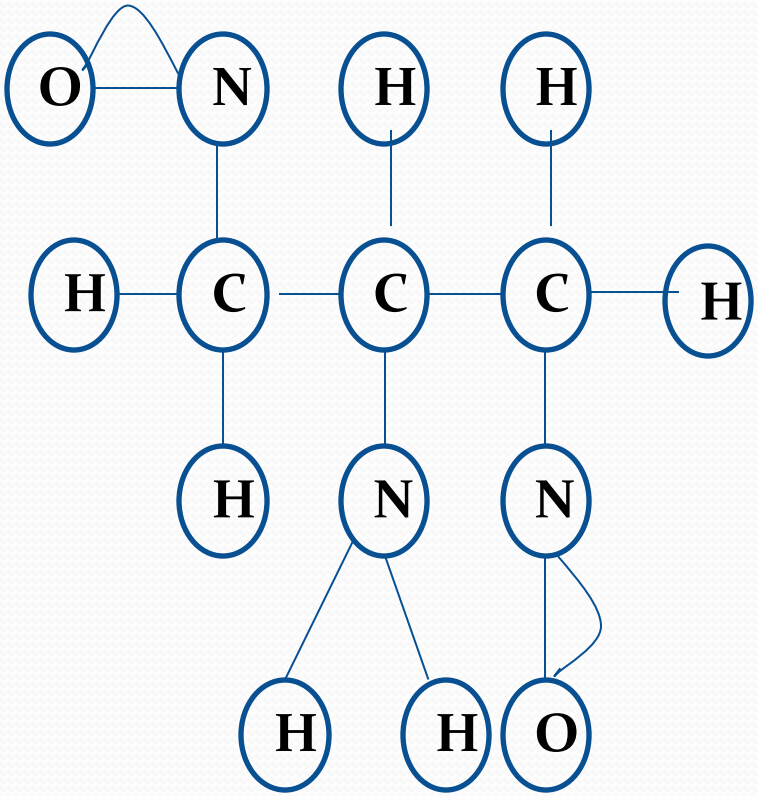
Facility location: *k*-median problem

- Given a weighted graph, specified vertices called *clients* Need to place facilities in *k* vertices in the graph which wil serve the clients best possible.
- Minimize the distance of a client to each closest facility.
- Facilities also have costs.

Determining if two compounds with the same formula are identical.

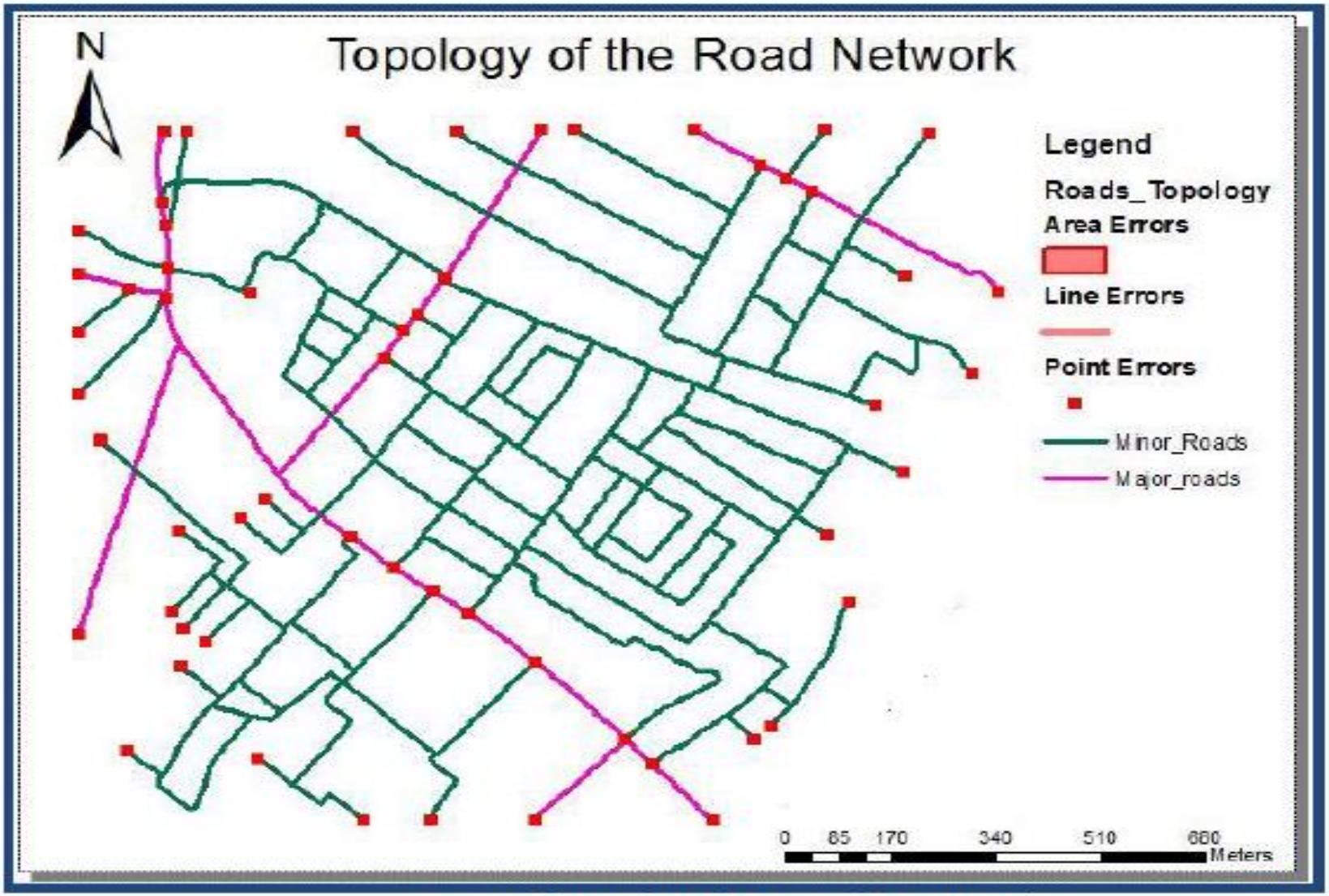


$C_3H_7N_2O_2$

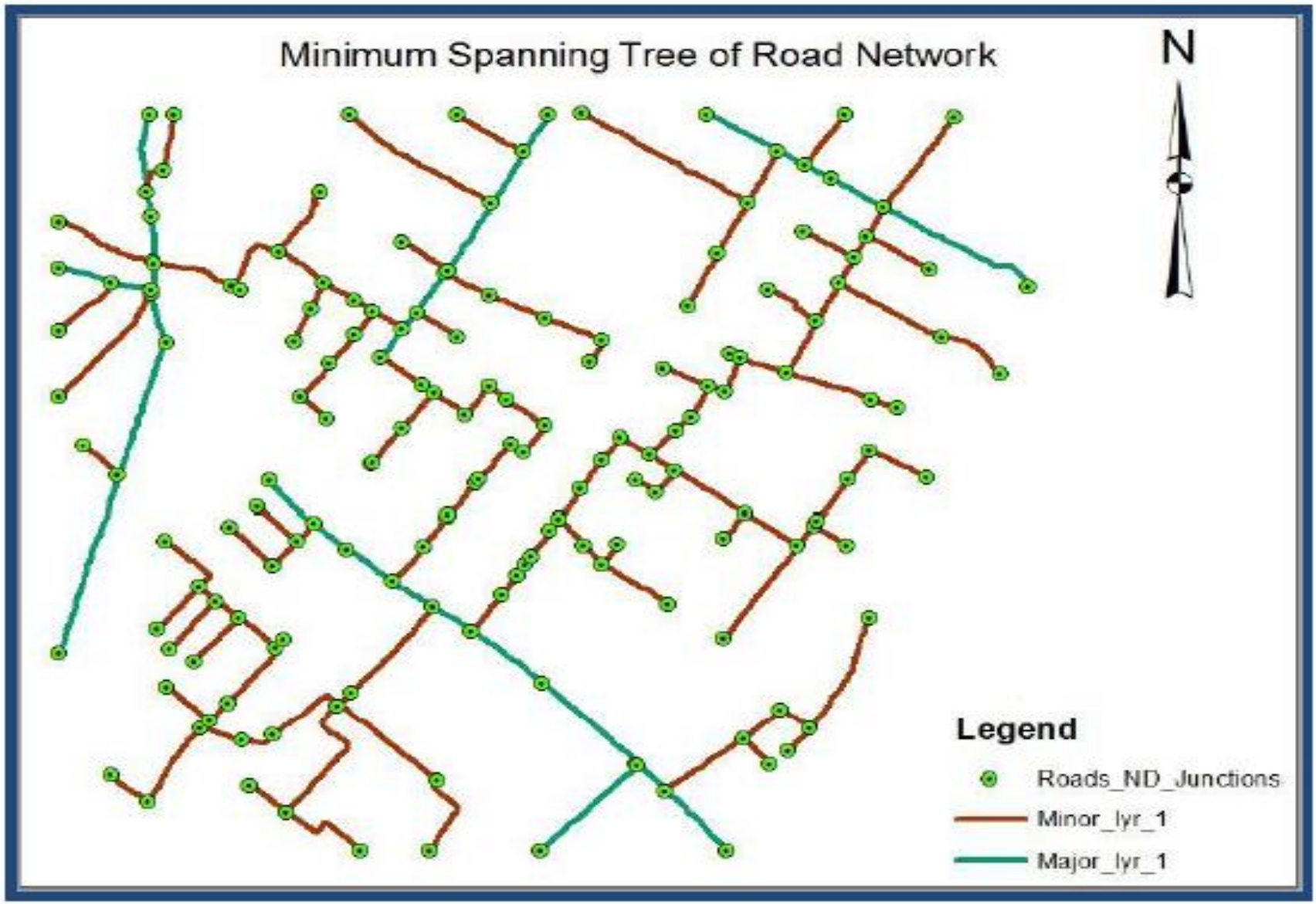


Graph isomorphism problem

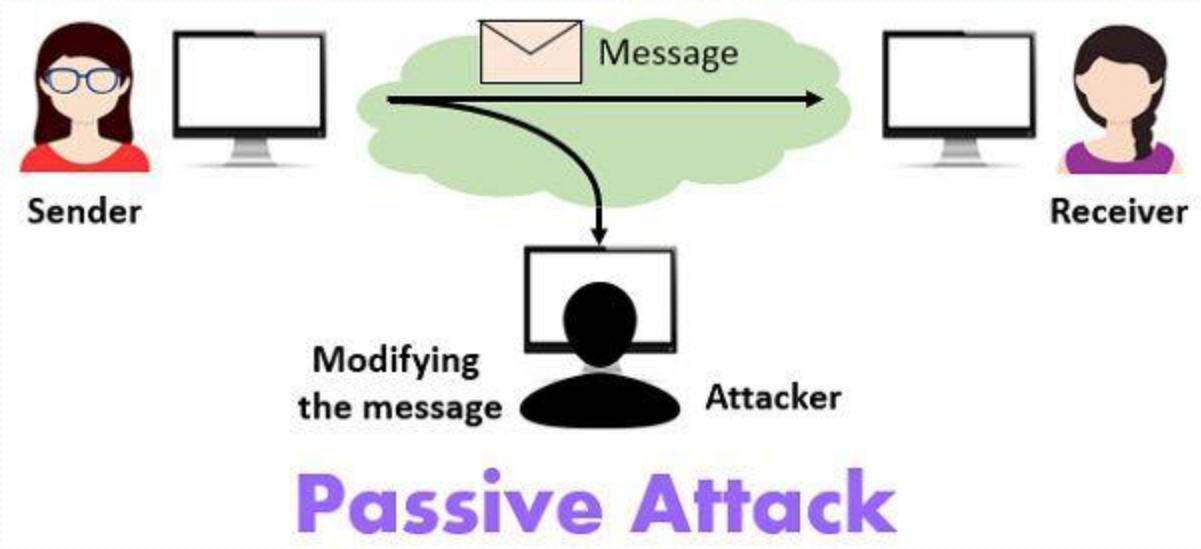
Minimum Spanning tree



Topology for the Road Network


Minimum Spanning Tree of Road Network
N
Legend
Roads_ND_Junctions
Minor_lyr_1
Major_lyr_1

Cryptography



Thank You